ABSTRACT

The present invention discloses a widely wavelength tunable polychrome colloidal photonic crystal device whose optical Bragg diffraction stop bands and higher energy bands wavelength, width and intensity can be tuned in a continuous and fine, rapid and reversible, reproducible and predictable fashion and over a broad spectral range by a controlled expansion or contraction of the colloidal photonic lattice dimension, effected by a predetermined change in the electronic configuration of the composite material. In its preferred embodiment, the material is a composite in the form of a film or a patterned film or shape of any dimension or array of shapes of any dimension comprised of an organized array of microspheres in a matrix of a cross-linked metallopolymer network with a continuously variable redox state of charge and fluid content. The chemo-mechanical and electro-mechanical optical response of the colloidal photonic crystal-metallopolymer gel is exceptionally fast and reversible, attaining its fully swollen state from the dry shrunken state and vice versa on a sub-second time-scale. These composite materials can be inverted by removal of the constituent microspheres from the aforementioned colloidal photonic crystal metallopolymer-gel network to create a macroporous metallopolymer-gel network inverse colloidal photonic crystal film or patterned film or shape of any dimension optical Bragg diffraction stop bands and higher energy bands wavelength, width and intensity can be redox tuned in a continuous and fine, rapid and reversible, reproducible and predictable fashion and over a broad spectral range by a controlled expansion or contraction of the colloidal photonic lattice dimensions.